First International GLAST Symposium Abstracts

16 January 2007

[*Please note: this version is preliminary for purposes of program planning. Full abstract information, including listed co-authors, will be provided in the Symposium book at registration. Please send an email to steve.ritz@nasa.gov if your contribution is missing or if you spot an error.*]

Monday 5 February

8-9 Registration, coffee, posters

9-10:30 1. Opening Session

9:00 Opening remarks, logistics
9:15 1.1 Overview of GLAST Mission and Opportunities - S. Ritz
9:40 1.2 The Large Area Telescope (LAT) - P.F. Michelson
10:10 1.3 The GLAST Burst Monitor (GBM) - C. Meegan

10:30-11:00 break, posters

11:00-12:00 2. AGN, EBL, and Related Topics (I)

11:00 2.1 AGN Populations and GLAST - P. Padovani
11:30 2.2 AGN Questions and GLAST - A.Celotti

12:00-13:30 lunch, posters

13:30 - 15:30 2. AGN, EBL, and Related Topics (II)

13:30 2.3 AGN, Radio Observations, and GLAST -G. Taylor
14:00 2.4 GLAST and the EBL - D.Hartmann
14:30 2.5 Multifrequency variability properties of gamma-bright AGN - S.

Wagner

All gamma-bright AGN display variability on all time-scales that have been explored so far. Together with correlated variations in other parts of the spectrum, the temporal characteristics provide important information about the physical conditions of the region emitting gamma-radiation. Full exploitation of the temporal information becomes challenging for Intraday variability. The temporal and broadband spectral characteristics of hard gamma-ray (VHE) emitting Blazars are used to extrapolate the challenges and promises of opening up intraday variability studies at GeV energies with the GLAST/LAT instrument.

14.45 2.6 Observations of AGNs with the MAGIC telescope -D. Mazin

MAGIC is the currently world's largest single dish ground based imaging atmospheric Cherenkov telescope. During the first year of operation, very high energy gamma-ray emission from several active galactic nuclei (AGNs) has been detected. Here we present an overview of the analyzed data, including discussion about spectral and temporal properties of the sources. In addition, we discuss implications of the measured energy spectra of distant AGNs to our knowledge about the extragalactic background light.

15:00 2.7 Towards an improved census of radio-loud AGNs: the FIRST Flat Spectrum Sample. -G. Fossati

The intrinsic demographics of blazar jets is poorly understood, and yet that is the essential first step toward understanding how Nature produces and powers jets. We are addressing this problem by developing a new large sample (600) of blazars, the *FIRST Flat Spectrum Sample* (FFSS), designed adopting a set of selection criteria ensuring the *maximal possible* representativity of all sub-classes of sources. The FFSS will afford us an unprecedented, comprehensive view of the blazar phenomenology. We are going to present an overview and selected results of the FFSS project. The goal is to shed light on the true nature and physical properties of radio-loud AGN through the understanding of the demographics of blazars, resolving the long standing uncertainty about nature of the relationship among power, colors and spectral types. The FFSS is "designed" to give us a true(r) census of blazars. In order to do so, it is crucial to strive to select in an unprejudiced way all "flavors" of blazar (e.g. not distinguish a priori between BL Lac and FSRQ), and to be sensitive to the whole –broad– range of the SED "colors". The FFSS is 95% identified. It comprises $\simeq$ 600 objects, selected from the FIRST radio survey, representing a very diverse mix of FSRQ (60%), BL Lacs (20%), and "galaxies" (15%), and it spans the full range of SED colors, with relatively uniform statistics. The multiwavelength coverage is excellent. The overlap with SDSS ensures homogeneous multicolor photometry for 3/4 of the sample, spectra for about 1/2. The 2MASS yields data for 60% of the sample. X-ray data are available for 2/3 of the sources, including archival and new Chandra/XMM observations for about 90 objects. Preliminary (and model dependent) estimates suggest that all FFSS objects will be detected by GLAST over the survey period, a good subsample over week-long timescales. We will report on our Chandra observations, on the progress towards addressing our first goal, testing the current luminosity/SED-color sequence paradigm, and on the relevance of/for GLAST for/of the FFSS.

15:15 2.8 Deep Blazar Surveys with Swift -P. Giommi

We present the first results of a systematic search for serendipitous blazars in Swift XRT X-ray images. As of today we have analyzed about 4000 exposures detecting over 70,000 X-ray sources. We expect to find several hundred of new blazars and radio galaxies. The main aims of this project are a) increase the number of known blazars that are in principle detecteble by GLAST and b) achieve the deepest and most uniform X-ray survey of blazars with flux limits of approx. 1.e-15 erg in the soft X-ray band (0.5-2.0 keV), and of about 10 mJy at radio frequencies (e.g. 5GHz) for LBL sources and well below 1 mJy for HBLs. For this deep survey we will use the very long (100,0000-500,000 seconds) XRT exposures performed to follow the $>$ 200 GRBs already detected. Our final sample will be less biased and more complete than sapmples from previous surveys. We will use it to derive the Radio and X-ray logN-logS, the luminosity function and the cosmological evolution of blazars and to derive the implications for Gamma-ray astrophysics.

15:30-15:45 break

15:45-17:05 3. Surveys, Populations, New Sources

15:45 3.1 New Source Classes and Spatially Extended Sources - D.Torres
16:15 3.2 The INTEGRAL High Energy Sky - P. Ubertini

INTEGRAL is continuing the deep observations of the Galaxy Plane and, at level of a mCrab, of the whole sky in the soft gamma ray range. The new IBIS catalogue contains more than 420 sources in detected in the 20-40 and 40-100 keV (Bird et al., in press). We will present an update of the INTEGRAL high energy sky (Bazzano et al., 2006) with particular regard to sources emitting beyond 100 keV, including jet sources, AGN and Blazars.

16:35 3.3 Galactic TeV Sources and GLAST -L.Drury

17:05-17:30 Posters

17:30-19:00 Reception

20:00 PUBLIC LECTURE. Prof. Andre Linde (Stanford) - The Origin and Fate of the Universe

For a long time scientists believed that our universe was born as an expanding spherically symmetric ball of fire. If the universe expands fast enough, it will expand forever, whereas if its expansion is slow, it will collapse and disappear. This scenario dramatically changed during the last 25 years. Now we think that initially the universe was rapidly inflating, being in an unstable energetic vacuum-like state. It became hot only later, when this vacuum-like state decayed. Quantum fluctuations produced during inflation are responsible for galaxy formation. In some places, these quantum fluctuations are so large that they can produce new rapidly expanding parts of the universe. This process transforms the universe into a huge fractal consisting of many exponentially large parts with different laws of low-energy physics operating in each of them. This picture became even more unusual lately, when string theory predicted that the total number of different laws of low-energy physics operating in different parts of the universe can also be exponentially large. According to string theory, each part of the cosmic fractal may eventually collapse into a huge black hole, or become 10 dimensional. However, the universe as a whole is immortal.

Tuesday 6 February

8-9 coffee, posters

9:00-10:45 4. Galactic Compact Objects and Their Environments (I)

9:00 4.1 Pulsar Questions and GLAST -A. Harding
9:30 4.2 Pulsar Observations and GLAST - S.Johnston
10:00 4.3 Finding (or not) New Gamma-ray Pulsars with GLAST -S. Ransom

Estimates for the number of pulsars that will be detected in blind searches with GLAST have ranged from tens to hundreds. I argue that the correct number will be on the (likely) very low end of this range, primarily due to observations made in a scanning as opposed to a pointing mode. I will discuss how blind pulsar searches will be carried out using GLAST, what limits these searches, and how the computations and statistics scale with various parameters. Given that there will likely only be a handful of new gamma-ray-only emitting pulsars discovered, close coordination with international radio observatories will be required to maximize GLAST's pulsar science in general.

10:15 4.4 Multiwavelength pulsar observations in support of GLAST -S.Thorsett

GLAST will address fundamental questions in pulsar emission physics and answer important questions about the pulsar population. However, most GLAST pulsar science will depend on the availability of contemporaneous broadband observations. Because of GLAST's sensitivity and the large number of pulsars it will observe, managing and prioritizing these observations is challenging. We review the value added to the mission by radio and x-ray pulsar studies, and describe the efforts already underway as well as those still needed if we are to optimize GLAST's science return.

10:30-11:15 coffee, posters

11.15 4.5 Supernova Remnants and GLAST - P.Slane
11:45 4.6 The Magnetic Bootstrap -R.Blandford

It appears that some supernova remnants accelerate cosmic rays to energies $\sim$0.1-1PeV. This requires that magnetic field must be amplified to a strength far in excess of the interstellar value.

It will be argued that this is due to non-resonant and resonant instabilities excited by the highest energy protons as they stream ahead of the shock front. These long wavelength magnetic modes provide the background magnetic field for the acceleration of lower energy particles with smaller Larmor radii. These ideas will be illustrated by application to RXJ 1713.7-3946. Future numerical studies will be suggested and the discriminatory nature of GLAST observations of supernova remnants will be described.

12-13:30 lunch

13:30-15:45 4. Galactic Compact Objects and Their Environments (II)

13:30 4.7 Binaries, Microquasars, and GLAST -G. Dubus

14:00 4.8 MAGIC observations of galactic objects -J. Cortina

This contribution summarizes the MAGIC Telescope observations of galactic objects carried out up to date, emphasizing some recent results on TeV 2032+4130, LS I +61 303, and other sources.

14:15 4.9 A deep INTEGRAL observation of the peculiar radio/X-ray/γ-ray/TeV source LS I +61 303 -W.Hermsen

We report on a deep INTEGRAL observation of the COS-B/EGRET source 3EG J0241+6103, which was already identified with the variable radio/X-ray source LS I +61 303 (Be X-ray binary with a 26.5 day period), and has recently been detected at TeV energies by MAGIC. It is one of three compact stellar X-ray binaries radiating at TeV energies which are also counterparts to EGRET sources. For two, PSR B1259-63 and LS I +61 303, the high-energy gamma-ray emission may be produced by the interaction of a pulsar wind with the wind from the companion star. For the third gamma-ray binary, LS 5039, a pulsar wind or a microquasar jet might power the system. INTEGRAL observed LS I +61 303 for an on-axis exposure of 1.1 Msec covering the complete 26.5-day orbital period and detected the binary up to energies of about 200 keV with an orbital light curve peaking at phase 0.55. The latter phase, shifted w.r.t. the phase of periastron passage at 0.23, is consistent with phases with flux maxima reported by EGRET and MAGIC, but shifted w.r.t. the radio phase. Detailed INTEGRAL findings will be presented. Furthermore, the variations in morphology of this orbital light curve from radio up to TeV energies, and the total high-energy spectrum from soft X-rays up to TeV energies will be presented and discussed in relation to the proposed model scenarios.

14:30-15:15 posters, coffee

15:15-16:35 5.Facilities

15:15 5.1 The AGILE Mission -M.Tavani

The AGILE Mission will explore the gamma-ray Universe with a very innovative instrument combining for the first time a gamma-ray imager (sensitive in the range 30 MeV - 50 GeV) and a hard X-ray imager (sensitive in the range 15-45 keV). An optimal angular resolution and a large field of view are obtained by the use of state-of-the-art Silicon detectors integrated in a very compact instrument. AGILE will be launched in Spring 2007 and it will provide crucial data for the study of Active Galactic Nuclei, Gamma-Ray Bursts, unidentified gamma-ray sources, Galactic compact objects, Supernova Remnants, TeV sources, and fundamental physics by microsecond timing. The possible coordination with GLAST will be presented.

15:35 5.2 Status of the VERITAS Gamma-Ray Observatory -D.Kieda

The VERITAS gamma ray observatory is an array of four 12-m diameter imaging Cherenkov telescopes located in Southern Arizona. All four telescopes have been recently deployed at the F.L Whipple Observatory basecamp, and have begun full operation starting January 2007. In this talk I will describe the operational status of the VERITAS Observatory, and will outline the initial performance of the instrument. I will also describe the long-term plan for the observatory, including the Key science projects and observation time allocation for the first two years of operation.

15:55 5.3 The Large Millimeter Telescope in the GLAST Era -A.Carraminana

The Large Millimeter Telescope (LMT) was inaugurated on November 22, 2006. LMT will soon start commissioning and is expected to enter full science operations by 2008. With a 50m aperture LMT will be the largest millimeter telescope and can become a powerful multiwavelength partner for GLAST. LMT will probe star formation at very high redshifts and can be used jointly with GLAST to uncover the firsts blazar engines. Used in target of opportunity mode LMT will be able to probe relativistic electrons within the jets of flaring AGNs and GRBs. It will map with high resolution the distribution of molecular gas in nearby galaxies and in extended molecular clouds, providing an important input for gamma-ray emission models. These possibilities are a sample of how the Large Millimiter Telescope, working in a coordinated manner with GLAST, can become a powerful tool for high energy astrophysics.

16:15 5.4 GLAST Large Area Telescope Multiwavelength Studies: An Invitation to Coordinated Observations -D.J.Thompson

High-energy gamma-ray sources are inherently nonthermal, multiwavelength objects. With the launch of the Gamma-ray Large Area Space Telescope (GLAST) scheduled for later this year, the GLAST Large Area Telescope (LAT) Collaboration invites cooperative efforts from observers at all wavelengths. Among the many topics where multiwavelength studies will maximize the scientific understanding, three stand out for particular emphasis: (1) Active Galactic Nuclei. The study of AGN gamma-ray jets through time variability and spectral modeling can help link the accretion processes close to the black hole with the large-scale interaction of the AGN with its environment. Gamma-ray AGN are also important in the study of absorption effects of extragalactic background light at high redshifts; (2) Unidentified Gamma-ray Sources. New gamma-ray sources need first to be identified with known objects seen at other wavelengths using position, spectrum, or time variability, and then multiwavelength studies can be used to explore the astrophysical implications of high-energy radiation from these sources; (3) Pulsar Timing. The LAT will be capable of some blind searches for new gamma-ray pulsars, but the deepest studies of these rotating neutron stars will come from having known radio or X-ray timing solutions. The need for long LAT observations calls for timing solutions valid (at least piecewise) over years. Observers interested in any type of coordinated observations should contact the LAT Multiwavelength Coordinating Group.

16:35-18:00 Posters

18:00 END OF POSTERS

19:00 BANQUET at Stanford Faculty Club

Wednesday 7 February

8-8:30 Coffee, discussion

8:30-10:00 6. Gamma Ray Bursts and Solar Physics

8:30 6.1 GRB Observations and GLAST -N. Gehrels
9:00 6.2 GRB Questions and GLAST - T.Piran
9:30 6.3 Pair Attenuation Signatures in Evolving Gamma-Ray Burst Spectra -M.Baring

Relativistic bulk motions have been invoked for a handful of gamma-ray bursts (GRBs) to explain the absence of attenuation of their spectra above 100 MeV, in data acquired by the EGRET experiment aboard the Compton Gamma-Ray Observatory. Such turnovers can be caused by pair creation involving photons internal to the burst emission region. In order to reduce the pair production optical depths below unity, higher bulk Lorentz factors are required. The anticipated launch in late 2007 of the Gamma-Ray Large Area Space Telescope (GLAST), with dramatically improved sensitivities in the 30 MeV-300 GeV energy band, will usher in an era of more stringent diagnostics on such bulk motions. Recent work exploring time-dependent expectations for burst spectral properties in the EGRET/GLAST band has identified distinctive spectral signatures and trends for internal pair creation turnovers. This has focused on single-component sources with prompt emission peaking only in the MeV. In this paper, we build upon this work by delving into the interesting case of GRB 941017. This EGRET-TASC burst has exhibited strong evidence of a second gamma-ray component that peaks above 100 MeV, which becomes more pronounced as the burst evolves. We model potential turnovers in this source to define how such evolution might provide useful emission region diagnostics, for example on whether the GRB outflow coasts at constant speed, or if the bulk Lorentz factor declines with time. This investigation serves as a template for multi-component, bright bursts that might be more amenable to subtle source diagnostics using GLAST, given that they may possess unusually high fluxes in the super-GeV band.

9:45 6.4 How may GLAST help solve some GRB Puzzles Raised by Swift -J.Granot

Early X-ray afterglow observations by Swift have found many new and interesting features, some of which are still not well understood. These include an early phase of shallow decay, which sometimes ends in a chromatic break that is seen in the X-rays but not in the optical. The early flat decay phase suggests, under standard assumptions, a very high efficiency of the prompt gamma-ray emission ($>\sim 90\%$), which is hard to achieve by internal shocks. GLAST observations of the prompt GRB emission may find out whether a high-energy spectral component carries more energy than the familiar prompt emission component (that usually peaks around a few hundred keV), which would further increase the efficiency requirements from the prompt emission. Such observations may also help pin down the prompt emission mechanism in GRBs. Furthermore, GLAST early afterglow ($\sim 300 - 10^4$ sec) observations could help shed light on the cause for the shallow decay phase, through a combined study of the high-energy observations by GLAST together with X-ray and optical light curves. This would in turn help check the validity of the standard assumptions which lead to a very high gamma-ray efficiency, and thus reduce the large current uncertainty on the true gamma-ray efficiency. High energy observations by GLAST may also improve our understanding of the mysterious chromatic breaks at the end of the flat decay phase (around 10^4 sec).

10:00 6.5 Surprising X-ray Properties of Swift Early Afterglows, Fodder for Glast - N.Butler

We have developed an automated reduction and analysis pipeline at Berkeley to rapidly study the Gamma-ray and X-ray properties of GRBs and their afterglows observed by Swift. We are interested in extending our analyses to also include GLAST data products. We have been at the forefront of establishing and explaining the early GRB and X-ray afterglow phenomenology. We summarize our findings and discuss the likely impact GLAST will have on further elucidating the mechanisms responsible the GRB and its afterglow.

10:15 6.6 BATSE Spectroscopy Detector Observations of GRB MeV Emission -M.Briggs

For much of the Compton GRO mission, two of the eight BATSE Spectroscopy Detectors (SDs) were operated at low gain. In this mode, the data extends to at least 20 MeV. Several GRBs were observed to have flux at 10 MeV and many more were observed in the few MeV region. Additionally, flux upper-limits constrain the value of beta, the slope of the high-energy power law. Using both a low-gain and a (regular) high-gain SD, spectral data is available from a few tens of keV to more than 20 MeV. Applying criteria of sufficient fluence for useful analysis, and that the GRB being observed is sufficiently close to the detector axis of both a low-gain and a regular-gain SD, a sample of about 20 GRBs is available. The analysis results will be reported, as will predictions for GLAST.

10:30-10:45 Break

10:45 6.7 Suzaku HXD-WAM observations of Gamma-ray Prompt Emis-

sion and Collaboration with GLAST -Y.Fukazawa

Suzaku HXD-WAM has a largest effective area around 300-5000keV for measurements of Gamma-ray burst (GRB) prompt emissions than other satellites including GLAST-GBM. The WAM detected 100-120 GRBs per year. The high sensitivity around 1MeV enables us to measure the Epeak and high energy tail more accurately than ever before. Then, collaboration with GLAST will give us opportunities to obtain high-sensitivity wide-band energy spectra and its time evolution from several keV to GeV band, together with the good cross-calibration data. Solar flare and earth-occultation monitoring of soft gamma-ray objects are also possible and interesting. Here we will report the performance and initial results of the HXD-WAM and indicate the sciences obtained by collaboration with GLAST.

11:00 6.8 Solar Science with GLAST -G.Share

11:30-13:00 lunch

13:00-15:00 Parallel Sessions P1, P2, P3, P4

15:00-15:30 break

15:30-17:30 Parallel Sessions P5, P6, P7, P8

17:45 Depart to Chabot Planetarium

19:00 Chabot Reception
20:00 Chabot Planetarium Show

Thursday 8 February

8-8:30 Coffee, discussion

8:30-10:00 7. Diffuse and Spatially Extended Emissions

8:30 7.1 Galactic Diffuse Gamma-ray Emissions -S.Digel
9:00 7.2 Extragalactic Diffuse Gamma-ray Emissions -C.Dermer
9:30 7.3 Discovery of TeV Gamma Ray Emission from the Cygnus Region with Milagro Using a New Background Rejection Technique -A.Abdo

The diffuse gamma radiation arising from the interaction of cosmic ray particles with matter and radiation in the Galaxy is one of the few probes available to study the origin of the cosmic rays. Milagro is a water Cherenkov detector that continuously views the entire overhead sky. The large field-of-view combined with the long observation time makes Milagro the most sensitive instrument available for the study of large, low surface brightness sources such as the diffuse gamma radiation arising from interactions of cosmic radiation with interstellar matter. Here we present a gamma-ray image of the Cygnus Region at energies near 12 TeV using a new background rejection technique. We have discovered both an extended source and a large area of diffuse gamma-ray emission. The new extended source, MGRO 2019+37, has an extent of 0.33 ± 0.14 degrees and a flux given by $E^2dN/dE = (3.49 \pm 0.47_{stat} \pm 1.05_{sys}) \times 10^{-12}$ TeVcm^{-2}s^{-1} at the median detected energy of 12 TeV assuming a differential source spectrum of $E^{-2.6}$. The flux form the diffuse emission from the Cygnus Region at 12 TeV is $E^2dN/dE = (4.18 \pm 0.52_{stat} \pm 1.26_{sys}) \times 10^{-12}$ TeVcm^{-2}s^{-1}sr^{-1} assuming a differential source spectrum of $E^{-2.6}$.

9:45 7.4 Soft gamma-ray galactic ridge emission as unveiled by SPI aboard INTEGRAL Abstract: -J.Knoedlseder

The origin of the soft gamma-ray (200 keV – 1 MeV) galactic ridge emission is one of the long-standing mysteries in the field of high-energy astrophysics. Population studies at lower energies have shown that emission from accreting compact objects gradually recedes in this domain, leaving place to another source of gamma-ray emission that is characterised by a hard power-law spectrum extending from ∼100 keV up to ∼100 MeV. The nature of this hard component has remained so far elusive, partly due to the lack of sufficiently sensitive imaging telescopes that would be able to unveil the spatial distribution of the emission. The SPI telescope aboard INTEGRAL allows now for the first time the simultaneous imaging of diffuse and point-like emission in the soft gamma-ray regime. We present here all-sky images of the soft gamma-ray continuum emission that clearly reveal the morphology of the different emission components. We compare the morphologies to plausible source distributions models and discuss the implications of our results on the nature of underlying emission processes. We put our results in perspective of GLAST studies of diffuse galactic continuum emission.

10:00-10:25 coffee

10:25-11:30 8.Dark Matter and New Physics Windows

10:25 8.1 Dark Matter, Structure, and GLAST -M.Kuhlen (TBC)

10:45 8.2 Overview of GLAST Searches for Milky Way Dark Matter Substructure -L.Wai

We give an overview of the GLAST Dark Matter and New Physics Group efforts in the area of Milky Way satellites and Milky Way halo, both theoretical and experimental. We outline the basic signatures, strategies, and experimental challenges for dark matter detection. We describe the current status of analysis techniques being developed to meet the experimental challenges. We describe how the various analyses can be reduced to a "model independent" framework, and how the various sensitivities using different techniques within GLAST compare with one another. We outline the experimental challenges involved with more precise follow-up of potential GLAST dark matter sources, and potential cross-checks with other experiments.

11:00 8.3 Detecting Dark Matter via the Proper Motion of Microhalos -S. Koushiappas I will discuss the prospects of detecting cold dark matter via the detection of proper motion of Milky Way microhalos. For dark matter particle candidates that couple to photons, such as SUSY dark matter, microhalos that survive in the present day Milky Way halo can potentially exhibit proper motion during the mission lifetime of a gamma-ray experiment such as GLAST. I show that the detection of at least one gamma-ray microhalo with measurable proper motion presents a unique identification of dark matter, and places a limit on the kinetic decoupling temperature and mass of a SUSY dark matter particle as less than 100 MeV and less than 600 GeV respectively.

11:15 8.3 On detection of Strange Quark Matter with GLAST -J.Conrad

Strange Quark Matter (SQM) is a proposed state of hadronic matter consisting of up, down and strange quarks. If this state is stable as proposed by various phenomenological models, there will most likely be a experimentally accessible component of strange quark matter particles (strangelets) in the cosmic ray flux. In GLAST the prime signature would be a lambda particle produced in hadronic interaction of the strangelet in the tracker, decaying into a proton and pion with relatively large opening angle. In this contribution we investigate the possibility for GLAST to measure these events and separate them from background.

11:30-12:15 9.Summary Session

11:30 9.1 Symposium Summary -R.Blandford

12:00 Announcements

12:15 Adjourn. Afternoon Satellite Meetings

Parallel Sessions

Parallel session talks are 10 minutes plus 5 minutes for questions and discussion.

P1+P5 AGN, EBL and Related

P1.1 Discovery of fast variability of the TeV gamma-ray flux from the radio galaxy M87 with H.E.S.S. -M.Beilicke

The giant radio galaxy M87 was observed at GeV/TeV gamma-ray energies with the H.E.S.S. (High Energy Stereoscopic System) Cherenkov telescopes in the years 2003-2006. The observations confirm M87 as the first extragalactic TeV gamma-ray source not of the blazar type (first indications of a signal were reported by the HEGRA collaboration earlier). The TeV gamma-ray flux from M87 as measured with H.E.S.S. was found to be variable on time-scales of days which strongly constrains the size of the emission region. The results (position, energy spectrum and light curve) as well as theoretical interpretations will be presented.

P1.2 Latest Discoveries from Blazar Observations by H.E.S.S. -A.Djannati-Atai

We report on the latest results obtained from VHE gamma-ray observations of blazars with HESS including the historical 2006 flare of PKS2155-304. We will present also the discovery of two distant objects, 1ES 0229+200 (z=0.140) and 1ES 0347-121 (z=0.185), and discuss possible implications on EBL upper limits derived from previous detections.

P1.3 Suzaku Observations of AGN and Synergy with GLAST -J.Kataoka

In next five years, dramatic progress will be made on AGN studies, as we have two important missions to observe celestial sources in the high energy regime: GLAST and Suzaku. Suzaku is the 5th Japanese X- ray astronomy satellite which was successfully launched in July 2005. It carries four X-ray sensitive imaging CCD cameras (0.2-12 keV) located in the focal plane of X-ray telescope, and the non-imaging, collimated hard X-ray detector, which extends bandpass of the observatory to 10-600 keV. Simultaneous monitoring observations by the two instrument (GLAST/Suzaku) will be particularly valuable for variable radio-loud AGN, allowing the cross-correlations of time series as well as detailed modeling of the spectral evolution between the X-ray and gamma-ray energy bands. I will give an overview of early observational results from Suzaku on AGN, and discuss what we can do with GLAST in forthcoming years. We present anticipated results from contemporaneous observations of AGN, in particular, jet-dominated sub-class of AGN known as blazars. We also discuss physics of new category sources, such as nearby radio galaxies that could be detectable for the first time with GLAST.

P1.4 Study of the Flux and Spectral Variations in the VHE Emission from the Blazar Markarian 501, with the MAGIC Telescope -D.Paneque

The blazar Markarian 501 (Mkn501) was observed above 100 GeV with the MAGIC Telescope during May, June and July 2005. The high sensitivity of the instrument made possible the detection of the source with high significance in each of the observing nights. As a result, not only the integrated gamma-ray flux, but also the shape of the differential photon spectra on night-by-night basis could be derived. During this observational campaign, the emitted gamma-ray flux from Mkn 501 was found to vary by one order of magnitude, and showed a high correlation with spectral changes. Intra-night flux variability was also observed, with flux-doubling times of less than 3 minutes. The data showed a clear evidence of a spectral peak (in the ?F? representation) during the nights when the gamma-ray activity was highest. The location of this spectral feature was found to be correlated with the emitted gamma-ray flux. This feature may be related to the Compton peak expected in leptonic models of blazar gamma-ray emission. In the symposium, the details of this unprecedented spectral and temporal analysis of Mkn501 observations in the very high energy range will be reported, and the implications of these results will be discussed.

P1.5 GLAST answers (and new questions) on high-energy peaked BLLacs -L.Costamante

High-energy peaked BLLacs (HBL) provide at present the most challenging tests for the jet emission models in blazars, in particular SSC and the one-zone scenario. Furthermore, the usual constraints on the main location of the dissipative events as well as jet compositions derived in FSRQ are not (or less) valid for HBL. The recent results from Cherenkov telescopes are challenging the common wisdom, with very hard TeV spectra (for EBL levels slightly higher than galaxy counts), extreme variability and TeV data difficult to match with past GeV (EGRET) results (e.g. PKS 2155-304). Here we will discuss some answers that GLAST can give to the questions raised by the TeV data. We will present new possible scenarios for hard spectra and the decisive observational tests that GLAST will provide (even in case of non detection). We will also briefly discuss the possibility to find even more extreme objects.

P1.6 The Spectral Sequence of Blazars and GLAST -L.Maraschi

The spectral sequence of blazars (Fossati et al. 1998) offers a suggestive indication that the basic properties of Blazar jets could be understood in terms of different powers involved. While, phenomenologically, different physical jet parameters are derived modeling their SEDs (Ghisellini et al. 1998) it is still unclear how these are related to the jet power. On the other hand the Jet-Disk connection in blazars suggests that high power jets are associated with luminous accretion disks while medium and low power jets are associated with underluminous accretion disks if any (Maraschi and Tavecchio 2003). We will discuss the progress in these issues expected from the GLAST discoveries. With its improved sensitivity with respect to EGRET, Glast will provide an assessment of the "average" gamma-ray luminosities of the sources allowing to remove the bias towards "flare luminosities" only accessible to EGRET. Thus the very concept of a spectral sequence will be under test. Moreover measuring the gamma-ray spectra of individual sources and their variability it will be possible to test the predictions of the phenomenological and physical scenarios presently envisaged. Specific examples will be presented.

P1.7 Linking Blazar and Accretion Disk Magnetic Fields -G.Bicknell

Simultaneous observations of either optical or IR or X-ray emission and (GeV - Tev) gamma-ray emission from blazars gives us information about the magnetic field, particle energy density and jet energy flux at distances of $10^2 - 10^3$ gravitational radii from the black hole. It is also possible to to estimate the magnetic field in the Poynting flux dominated region of accretion disks close to the black hole and then to extrapolate this to the blazar region using a model for jet propagation in the first 10^{18} cm. One of the conclusions of this process is that pure SSC models for blazar emission overestimate the magnetic field in the blazar region. Better agreement between the extrapolated and inverse-Compton-estimated fields is obtained if the seed photons for the inverse Compton emission originate from a larger region than that occupied by the high energy electrons that are responsible for the scattering. Specific examples include MRK 421, MRK 501 and PKS 2155-305. The implications of recent TeV data on M87 will also be considered.

P1.8 The Spectral Index Distribution of EGRET Blazars: Prospects for GLAST -T.Venters

The study of the diffuse extra-galactic gamma-ray background (EGRB) provides insight into the high-energy processes of the universe. It has been suggested that the diffuse EGRB could be an indication of exotic physics at work. However, in order to determine what roles exotic physics might play, it is necessary to understand those of known astrophysical gamma-ray emitters, particularly blazars, which comprise the class with the largest number of identified members. A critical input in determining the spectral shape of the unresolved blazar contribution to the EGRB is the intrinsic distribution of blazar spectral indicies in GeV energies. Therefore, in recognizing its importance, we develop a method of determining the intrinsic spectral index distributions (ISID) for EGRET and GLAST (as data become available) FSRQs and BL Lacs, which accounts for error in measurement of individual spectral indices. We find that FSRQs and BL Lacs do have different ISIDs (with BL Lacs being harder) and that the spreads in both distributions are much narrower than one would conclude if measurement error had not been taken into account. This implies that the curvature of the unresolved blazar spectrum, in turn, is smaller than calculated in the past. We also test for spectral index hardening associated with blazar variability, and we find no evidence of this phenomenon. Finally, we produce simulated GLAST spectral index datasets and perform the same analyses. We find that since GLAST will detect many more blazars than EGRET did, GLAST will provide better statistics in determining the ISIDs, testing for spectral index hardening, and investigating the variability of blazars. Therefore, GLAST will provide a much more rigorous determination of the spectral shape of the blazar contribution to the EGRB and will play a critical role in addressing currently unanswered questions.

P5.1 Intergalactic Photon Spectra from the Far IR to the UV Lyman Limit for $0 < z < 6$ and the Optical Depth of the Universe to High Energy Gamma-Rays -F.Stecker

We calculate the intergalactic photon density as a function of both energy and redshift for $0 < z < 6$ for photon energies from .003 eV to the Lyman limit cutoff at 13.6 eV in a Λ-CDM universe with $\Omega_\Lambda = 0.7$ and $\Omega_m = 0.3$. Our galaxy evolution model gives results which are consistent with Spitzer deep number counts and the spectral energy distribution of the extragalactic background radiation. We use our photon density results to extend previous work on the absorption of high energy gamma-rays in intergalactic space owing to interactions with low energy photons and the 2.7 K cosmic background radiation. We calculate the optical depth of the universe, τ, for gamma-rays having energies from 4 GeV to 100 TeV emitted by sources at redshifts from 0 to 5. We also give parametric fits with numerical coefficients for approximating $\tau(E_\gamma, z)$. As an example of the application of our results, we calculate the absorbed spectrum of the blazar PKS 2155-304 at z = 0.117 and compare it with the spectrum observed by the H.E.S.S. air Cherenkov gamma-ray telescope array. We also derive a new and user friendly simple analytic approximation for determining the effect of intergalactic absorption in the energy range 0.2-2 TeV and the redshift range 0.05-0.4. In these ranges, the form of the absorption coeeficient is approximately logarithmic in energy. The effect of this energy dependence is to steepen intrinsic source spectra such that a source with an approximate power-law intrinsic spectrum in this energy range with spectral index Γ_s is steepened to a power-law with an observed spectral index $\Gamma_o = \Gamma_s + \Delta\Gamma(z)$ where $\Delta\Gamma(z)$ is a linear function of z in the redshift range 0.05-0.4. We apply this approximation to the spectra of seven TeV blazars.

P5.2 Generic Limits on the Density of the Extragalactic Background Light from TeV Blazars -D.Mazin

The diffuse extragalactic background light (EBL) in the UV to far IR wavelength regime carries important information about the galaxy and star formation history of the universe. The present level of the EBL is made up of the over all epochs integrated and, correspondingly to its formation epoch, redshifted electromagnetic radiation. Direct measurements of the EBL have proven to be a difficult task due to dominant foregrounds mainly from inter-planetary dust (zodiacal light) and it is not expected that the sensitivity of measurements will greatly improve over the next years. The observation of distant sources of TeV photons via Imaging Cherenkov Telescopes can provide an indirect measurement of the EBL: The TeV photons are attenuated via pair production and the observed spectra therefore carry an imprint of the EBL. With assumptions about the source spectrum limits on the EBL can be derived. We adopted a grid scan on the EBL density using spline functions, which allowed us to test over 8 million different EBL shapes making the scan to be independent from any predefined shape between 0.8 and 80 microns. Here we present upper limits on the EBL density using energy spectra from all detected TeV blazars. Compared to previous studies, the derived upper limits are the strongest in the range between 3 and 60 microns so far.

P5.3 Isolating Cosmic Infrared Background from First Stars with GLAST Measurements of High-z GRBs and Blazars -A.Kashlinsky

I will discuss the contribution of Population III stars to the near-IR (NIR) cosmic infrared background (CIB) and its effect on spectra of high-z gamma-ray bursts (GRBs) and other sources detectable with GLAST. The evidence for substantial CIB emissions originiating from high z now comes from measurements of CIB fluctuations in deep Spitzer data. If Population III were massive stars, the claimed NIR CIB excess will be reproduced if only $\sim 4 \pm 2\%$ of all baryons went through these stars. Regardless of the precise amount of the NIR CIB from them, they likely left enough photons to provide a large optical depth for high-energy photons from distant GRBs. Observations of such GRBs are expected in the course of the GLAST mission. Detecting such damping in the spectra of high-z GLAST soruces will then provide important information on the emissions from the Population III epoch and location of this cutoff may serve as an indicator of the GRB's redshift.

P5.4 A Figure of Merit for Blazar-like Source Identification in the Gamma-ray Energy Band -E.Cavazzuti

The microwave to gamma-ray spectral slope could be used as a viable figure of merit for blazar-like GLAST source identification. Taking into account the constraints from the observed extragalactic gamma-ray background, based on the results of a recently derived blazar radio LogN-LogS obtained by combining several multi-frequency surveys, one can estimate the maximum duty cycle allowed for the observed blazar candidates. This provides an indicator of goodness of the source identification. We present our preliminary results and predictions for GLAST.

P5.5 Ground Support for GLAST: simultaneous radio- to sub-mm monitor-

ing of variability and spectral shape evolution of GLAST blazars - L.Fuhrmann

The LAT instrument on-board GLAST will provide a tremendous opportunity for future blazar studies. In order to fully benefit from the offered capabilities of this instrument and to interpret the high energy emission, it is of great importance to conduct dedicated ground-based multi-frequency campaigns that will produce comprehensive observations prior to and after the GLAST launch. Here, we present a more detailed overview of our radio- to sub-mm efforts within the GLAST LAT AGN working group aiming at a densely time-sampled, long-term and broad band monitoring of a large sample of potential GLAST blazars. We describe the scientific motivation as well as the participating cm- to sub-mm facilities (such as the OVRO, Effelsberg, IRAM, SMTO and SMA telescopes) and their observing strategies. The planned campaign will allow to regularly obtain (quasi-) simultaneous variability and spectral data for these sources over the next years. Together with the multi-wavelength efforts of the LAT AGN working group at other spectral bands (optical/IR, X-ray) as well as VLBI, these observations will finally provide an invaluable broad-band data base for the interpretation/understanding of the future high energy blazar emission recorded by the LAT and the physics of blazars in general.

P5.6 X-Raying the MOJAVE Sample of Compact Extragalactic Radio Jets -M.Kadler

The MOJAVE sample is the first large radio-selected, VLBI-monitored AGN sample for which complete X-ray spectral information is being gathered. We report on the status of *Swift* survey observations which complement the available archival X-ray data at 0.2-10 keV and in the UV with its XRT and UVOT instruments. Many of these 133 radio-brightest AGN in the northern sky are now being observed for the first time at these energies. In addition, the number of MOJAVE sources detected by the BAT instrument onboard *Swift* in the hard X-ray band is continuously growing. We present preliminary results and discuss further applications of this unique growing data base awaiting its upcoming high-energy-end completion with GLAST/LAT.

P5.7 Use of Multiwaveband Polarization and Light Curves to Identify Sites of Gamma-Ray Emission in Blazar Jets -A.Marscher

The ability of VLBI imaging and multiwaveband variability to probe the jets of blazars is greatly enhanced if a link can be established between features on the images and events in the light curves. Polarization provides a method for doing this. I will describe a method for combining VLBA and optical polarization monitoring to identify the site on the VLBA images where the variable optical emission occurs. Correlation between the optical and X-ray and/or gamma-ray light curve then establishes an association of the emission across the electromagnetic spectrum with a particular feature on the images. We have applied this method to a small number of objects that we monitor with the VLBA at 43 GHz, RXTE at X-ray energies, and Lowell, Steward, and the Crimean Astrophysical observatories in the optical.

P5.8 A Plan for the GLAST-LAT Blazars Multiwavelength Campaigns in 2008 -G.Tosti

The GLAST LAT instrument will monitor the GeV gamma-ray sky with uniform exposure and high sensitivity. It will obtain a snapshot of the entire sky in a few hours and thus will allow us to observe, simultaneously, the emission of many blazars, having different level of activity (flaring, intermediate and steady states), with good timing and spectral resolution. Because of the broad band emission of blazars (from radio to TeV), LAT data should be combined with those obtained at all other wavelengths so that, from the comparison of the observed multi-epoch spectral energy distributions (SEDs) with the outputs of time-dependent emission models, we may derive most the parameters which characterize the physical conditions of a source. The LAT Science Working Group on Blazars and Other AGNs is developing a Multiwavelength (MW) campaigns plan including: Target of Opportunity (ToO) on flaring sources; MW Intensive Planned Campaigns (MW-IPCs) on a few selected sources; MW Long-Term monitoring of several sources. In this poster, we present the MW campaigns we are planning for 2008. We discuss the scientific motivations, the LAT simulations an performances, the possible observing strategies, the other facilities needed and some preliminary guidelines on how radio to TeV observers can provide their support to the blazar MW campaigns .

P2 Diffuse and Extended Sources; Dark Matter and New Physics Windows

P2.1 Gamma-Rays Produced in Cosmic-Ray Interactions and the TeV-band Spectrum of RX J1713-3946 -C.Huang

In this work we study the individual contribution to diffuse γ-ray emission from the secondary products in hadronic interactions generated by cosmic rays (CRs), in addition to the contribution of π^0 decay via the decay mode $\pi^0 \to 2\gamma$. For that purpose we employ the Monte Carlo particle collision code DPMJET3.04 to determine the multiplicity spectra of various secondary particles with γ's as the final decay state, that result from inelastic collisions between cosmic-ray protons and Helium nuclei and the interstellar medium with standard composition. By combining the simulation results with a parametric model of γ-ray production by cosmic rays with energies below a few GeV, where DPMJET appears unreliable, we thus derive an easy-to-use γ-ray production matrix for cosmic ray up to about 10 PeV, that can be used to interpret the γ-ray spectra of diffuse galactic emission and supernova remnants (SNR). We apply the γ-ray production matrix to the GeV excess in diffuse galactic γ-rays that was seen with EGRET. Although the non-π^0 contributions to the total emission have a different spectrum than the π^0-decay component, they are insufficient to explain the GeV excess. We also test the hypothesis that the TeV-band γ-ray emission of the shell-type SNR RX J1713-3946, that was observed with HESS, is caused by shock-accelerated hadronic cosmic rays. This scenario implies a very high efficacy of particle acceleration, so the particle spectrum is expected to continuously harden toward high energies on account of cosmic-ray modification of the shock. Using the χ^2 statistic we find that a continuously softening spectrum is strongly preferred, in contrast to expectations. A hardening spectrum has about 1% probability to explain the HESS data, but then only if a hard cut-off at 50-100 TeV is imposed on the particle spectrum.

P2.2 Survey of the Galactic Plane at 12 TeV with Milagro -C.Lansdell

The Milagro Gamma-Ray Observatory is a water Cherenkov detector that operates continuously, detecting extensive air showers from the overhead sky. The large field of view and long observation time of Milagro is ideal for surveying large regions of the Northern Hemisphere sky and for detecting gamma rays at the highest energies. The emission from the entire inner galaxy as visible from the Northern Hemisphere – Galactic latitude $\mid b \mid < 5^\circ$ and Galactic longitude $l \in [30^\circ, 120^\circ]$ – is detected at a median energy of 12 TeV with a significance of > 7 standard deviations above the isotropic background. The flux of this region exceeds that predicted from cosmic ray interactions with matter and radiation. However, discrete sources will contribute to this flux and 6 locations within this inner Galaxy region are more than 4.5 standard deviations above the isotropic background. Given the size of the inner Galaxy selected and the search method, 0.3 locations are expected above 4.5 standard deviations by chance, if the background is isotropic. The flux of the inner galaxy and of these 6 excess locations will be reported.

P2.3 The 3-D distribution of gas in the Milky Way Galaxy -M.Pohl

Results will be reported of an ongoing study of the three-dimensional distribution of interstellar gas in the Milky Way Galaxy. Knowledge of the gas distribution is important for any analysis of diffuse galactic gamma rays, whether aiming at cosmic-ray physics or dark-matter signatures. Our investigations are based on a kinematic model for the inner Galaxy that includes a galactic bar as well as radial and non-axisymmetric flows. We also attempt to account for hydrogen self-absorption.

P2.4 The History of Cosmic Rays in Normal Galaxies: Gamma-Ray and Lithium Fossils -B.Fields

Emission from our own Galaxy dominates the diffuse gamma-ray sky, and presumably reflects the interactions of cosmic rays propagating in the interstellar gas and photon fields. Moreover, the brightness of the Milky Way implies the existence of a diffuse extragalactic signal from unresolved external galaxies, integrated out to cosmological distances. This component of the extragalactic gamma-ray background reflects the *cosmic* history of cosmic-ray production and interstellar matter in normal galaxies. We will show that GLAST is likely to detect this signal as a feature around 1 GeV, particularly if the extragalactic signal at other energies is dominated by emission from unresolved AGN. We further point out that an independent constraint on the *local* history of *hadronic* cosmic rays comes from the interstellar production of lithium isotopes, predominantly via the $\alpha + \alpha \to {}^{6,7}\mathrm{Li} + \cdots$ fusion reaction. The extragalactic gamma-ray signal and local lithium abundances should be tightly linked. However, the local ${}^{6}\mathrm{Li}$ abundance demands a gamma-ray intensity which exceeds the most generous estimates using EGRET data. GLAST observations *or limits* on normal-galaxy emission will clarify this issue, and have implications for primordial ${}^{6}\mathrm{Li}$ production by decaying dark matter and by cosmic rays from cosmological structure formation.

P2.5 Guaranteed Unresolved Point Source Emission and the Gamma-ray Background -V.Pavlidou

The diffuse extragalactic gamma-ray background above 100 MeV encodes unique information about high-energy processes in the universe. In order to be able to use this emission to constrain exotic high-energy physics, it is essential that we first understand what fraction of it can be attributed to extragalactic unresolved point sources of known types. Blazars and normal galaxies are the two classes of gamma-ray emitters detected by EGRET with already identified members. GLAST will detect many more members of these classes and will strengthen our understanding of their respective unresolved components. However, the large majority of EGRET point sources remain without an identified low-energy counterpart. Whatever the nature of the EGRET unidentified sources, faint unresolved objects of the same class must have a contribution to the diffuse gamma-ray background, either directly (if most of them are extragalactic) or through their normal-galaxy hosts (if most of them are Galactic). Here, we follow an empirical approach to estimate the potential contribution of unidentified sources to the extragalactic gamma-ray background and we find that it is likely to be important. Additionally, we show how upcoming GLAST observations of EGRET unidentified sources, as well as of their fainter counterparts, combined with GLAST observations of the Galactic and extragalactic diffuse backgrounds, can shed light on the nature of the EGRET unidentified sources even *without* any positional association of such sources with low-energy counterparts.

P2.6 Can the LAT detect gamma-ray emission from the extended radio features of radio galaxies? -R.Sambruna

Recently, high-sensitivity X-ray and TeV detectors have shown that high-energy emission from the jets and lobes of radio galaxies is common. In particular, the hard X-ray spectra measured with Chandra from powerful jets imply that a large fraction of the bolometric luminosity of these systems is emitted above the X-ray band. Gamma-ray emission in the MeV to TeV range is also predicted by theoretical models for jet multiwavelength emission. Motivated by these findings, we explore the possibility of detecting radio galaxies at MeV-GeV gamma-rays with GLAST. Using a PSF generation algorithm and image deconvolution techniques, we perform detailed simulations for selected candidates, and investigate the constraints on theoretical models that can be obtained from the LAT detection.

P2.7 Will GLAST Identify Dark Matter? -J.Taylor

The nature of the cosmic dark matter is unknown. One strong possibility is that dark matter consists of weakly interacting massive particles (WIMPs) in the 100 GeV mass range. Such particles would annihilate in the galactic halo, producing high-energy gamma rays. I discuss the ability of GLAST to distinguish between WIMP annihilation sources and known astrophysical source classes. Focusing on the emission from the halo substructure predicted by the cold dark matter model, the WIMP gamma-ray spectrum is nearly unique; separation from known source classes can be done in a convincing way by including spectral and spatial information. Astrophysical detection of dark matter by GLAST would be particularly timely, given the new probes of this energy range that will be available at the Large Hadron Collider, starting in 2008.

P2.8 WIMP Gamma Rays From the Galactic Center with GLAST and Accelerator Comparison -A.Morselli

We present a study of the GLAST capability to detect a gamma-ray flux coming from pair WIMP annihilations at the GC against a standard astrophysical background. The GLAST reach computation is performed in a generic model independent scenario and in the context of the mSUGRA. In the last case we also show a comparison of the parameter space explorable by GLAST and by the upcoming accelerator experiments.

P3 Facilities, Techniques, and Calibrations

P3.1 Studies of EGRET unidentified sources with a novel image restoration technique -H.Tajima

We have developed an image restoration technique based on the Richardson-Lucy algorithm optimized for GLAST-LAT image analysis. Our algorithm is original since it utilizes the PSF (point spread function) that is calculated for each event. This is critical for EGRET and GLAST-LAT image analysis since the PSF depends on the energy and angle of incident gamma-rays and varies by more than one order of magnitude. EGRET and GLAST-LAT image analysis also faces Poisson noise due to low photon statistics. Our technique incorporates wavelet filtering to minimize such effect. We present studies of EGRET unidentified sources using this novel image restoration technique for possible identification of extended gamma-ray sources.

P3.2 A Time Differencing Technique for Detecting Radio-Quiet Gamma-Ray Pulsars -R.Johnson

Detecting periodicity from a gamma-ray pulsar is exceedingly difficult without prior knowledge of its pulsation frequency and frequency derivative. The low fluxes attainable in the gamma-ray band mandate very long exposures, making the direct application of Fourier analysis methods computationally prohibitive. Accumulation of phase shifts induced by significant frequency derivatives requires that the large Fourier transforms be repeated over many trials, and occasional "glitches" in the pulsar rotation compound the difficulties. By analyzing the differences of photon arrival times rather than the time series itself, we show that we can maintain good sensitivity while greatly reducing the effects of frequency derivatives and glitches. To demonstrate its power, we use simulated data to compare our time differencing algorithm with two Fourier methods used in previous searches for radio-quiet gamma-ray pulsars.

P3.3 Particle beam tests for the GLAST-LAT -L.Latronico

The calibration strategy of the GLAST Large Area Telescope combines analysis of cosmic ray data with accelerator particle beams measurements. An advanced MonteCarlo simulation of the LAT, based on the Geant4 package, was setup to reproduce the LAT response to such radiation, benchmark its performance throughout its entire operation and refine background rejection strategies. To validate the LAT simulation, a massive campaign of particle beam tests was performed between July and November 2006, in parallel with the LAT integration and test, on the LAT Calibration Unit (CU). This is a detector built with two complete flight spare modules, a third spare calorimeter module, five antocoincidence tiles located around the telescope and flight-like readout electronics. The CU was exposed to a large variety of beams, representing the whole spectrum of the signal that will be detected by the LAT, using the CERN and the GSI accelerator facilities.

Beams of photons (0-2.5GeV), electrons (2-300GeV), hadrons (pions and protons, GeV-100GeV) and ions (C, Xe, 1.5GeV/n) were shot through the CU to measure the physical processes taking place in the detector and eventually fine-tune their description in the LAT MonteCarlo simulation. This talk describes the motivations and goals of the test runs, the many different experimental setup used to select the required particles and trigger the CU, the measured performance of the CU and the first results of the LAT MonteCarlo validation.

P3.4 Measuring the PSF and the energy resolution with the GLAST-LAT Calibration Unit -P.Bruel

Because of the large phase space of the LAT and its complex structure, an advanced MonteCarlo simulation of the LAT, based on the Geant4 package, is used to optimize the instrument response functions and the background rejection. Testing the instrument with real beams at accelerator facilities was needed to make sure that this simulation is able to reproduce real data. Between July and September 2006, we have tested the LAT Calibration Unit (CU) at CERN, both at PS and SPS accelerators. The CU is a detector built with two complete flight spare modules, a third spare calorimeter module, five anticoincidence tiles located around the telescope and flight-like readout electronics. The CU was exposed to gamma beams (from 50 MeV up to 2.5 GeV) and electron beams (from 2 GeV up to 280 GeV) in many configurations (various incoming angles and impact points) in order to cover the large phase space of the LAT. This large amount of data will allow us to determine the performances of the LAT, such as PSF and energy resolution. This poster will present the preliminary results on these topics.

P3.5 Instrument Response Modeling and Simulation for the GLAST Burst Monitor -R.M.Kippen

The GLAST Burst Monitor (GBM) is designed to provide wide field of view observations of gamma-ray bursts and other fast transient sources in the energy range 10 keV to 30 MeV. The GBM is composed of several unshielded and uncollimated scintillation detectors (twelve NaI and two BGO) that are widely dispersed about the GLAST spacecraft. As a result, reconstructing source locations, energy spectra, and temporal properties from GBM data requires detailed knowledge of the detectors' response to both direct radiation as well as that scattered from the spacecraft and Earth's atmosphere. This full GBM instrument response will be captured in the form of a response function database that is derived from computer modeling and simulation. The simulation system is based on the GEANT4 Monte Carlo radiation transport simulation toolset, and is being extensively validated against calibrated experimental GBM data. We discuss the architecture of the GBM simulation and modeling system and describe how its products will be used for analysis of observed GBM data. Companion papers describe the status of validating the system.

P3.6 Three advantages of the KANATA 1.5-m telescope as a powerful partner for GLAST -M.Uemura

We propose possible multiwavelength collaborations between GLAST and our new 1.5-m telescope "KANATA", which has been developed by Hiroshima University in 2006 May. KANATA has three noteworthy characteristics with unique instruments, that is, i) a high flexibility of observation times, which enables prompt observations of transients and new sources, ii) polarimetric observations, which provide crucial clues for jet sources like blazars and microquasars, iii) simultaneous optical and infrared observations, which are essential to study short-term variations of SEDs of gamma-ray sources. In our presentation, we introduce the detailed information about the KANATA's performance (limiting magnitudes, observation mode, etc.), initial results including recent GRBs, and finally some ideas for collaborations between GLAST and KANATA.

P3.7 The Advanced Compton Telescope -S.Boggs

The Advanced Compton Telescpe (ACT), NASA's next major step in gamma-ray astronomy, will probe the fires where chemical elements are formed by enabling high resolution spectroscopy of nuclear emission from supernova explosions. During the past two years, our collaboration has been undertaking a NASA mission concept study for ACT. This study was designed to (1) transform the key scientific objectives into specific instrument requirements, (2) to identify the most promising technologies to meet those requirements, and (3) to design a viable mission concept for this instrument. We will present the results of this study, including scientific goals and expected performance, mission design, and technology recommendations.

P3.8 Jets, Blazars and the EBL in the GLAST-EXIST Era -J.Grindlay

The synergy of GLAST and the proposed EXIST mission as the Black Hole Finder Probe in the Beyond Einstein Program is remarkable. With its full-sky per orbit hard X-ray imaging (3-600 keV) and "nuFnu" sensitivity comparable to GLAST, EXIST could measure variability and spectra in the hard X-ray synchrotron component simultaneous with GLAST (10-100GeV) measures of the inverse Compton component, thereby uniquely constraining intrinsic source spectra and allowing measured high energy spectral breaks to measure the cosmic diffuse extra-galactic background light (EBL) by determining the intervening diffuse IR photon field required to yield the observed break from photon-photon absorption. Such studies also constrain the physics of jets (and the validity of SSC models) and the origin of the ¿100 MeV gamma-ray diffuse background likely arising from Blazars and jet-dominated sources. An overview of the EXIST mission, which could fly in the GLAST era, is given together with a synopsis of other key synergies of GLAST-EXIST science.

P4 Galactic Compact Objects and Their Environments

P4.1 Diffusive Shock Acceleration with Magnetic Field Amplification in SNRs -D.Ellison

Recent observations and modeling suggest the presence of large magnetic fields in supernova remnants (SNRs). We present a Monte Carlo model of nonlinear diffusive shock acceleration allowing for the generation of large-amplitude magnetic turbulence and show preliminary results where the ambient field is amplified by large factors. This model is the first to include strong wave generation, efficient particle acceleration to relativistic energies in nonrelativistic shocks, and thermal particle injection in an internally self-consistent manner. The presence of large magnetic fields in

SNRs will strongly influence the production of relativistic ions and electrons and impact broadband photon observations, particularly the mixture of inverse-Compton and pion-decay emission in the GeV-TeV energy range relevant for GLAST.

P4.2 Particle Acceleration and Radiation in Gamma-Ray Sources -E.Liang

Using multi-dimensional Particle-in-Cell simulations we have studied particle acceleration and radiation in electromagnetic-dominated outflows and collisionless shocks. We find that magnetic fields play critical roles in the acceleration of power-law electrons and positrons. Power-law indices of 2-4 are ubiquitous in our simulations. In most cases, the highest energy electrons do not radiate in-situ synchrotron radiation due to parallelism between the accelerating force and particle momentum. We also find that ion acceleration is highly sensitive to the positron loading of the plasma. Implications for the relation between gamma-ray sources and cosmic ray sources will be discussed.

P4.3 Massive stars in colliding wind systems: the GLAST perspective -A.Reimer

Colliding winds of massive stars in binary systems are considered as candidate sites of non-thermal high-energy photon emission. They already range among suggested counterparts for a few individual unidentified EGRET sources, but may constitute a detectable source population for the GLAST observatory. The present work investigates such population study of massive colliding wind systems at high-energy gamma-rays. Based on the recent detailed model (Reimer et al. 2006) for non-thermal photon production in the archetypal WR 140 and WR 147 systems, we unveil the expected characteristics of this source class in the observables accessible at LAT energies. Combining the broadband emission model with the presently cataloged distribution of such systems and their individual parameters allows to conclude on the expected maximum number of LAT-detections among massive stars in colliding wind binary systems.

P4.4 HESSJ1023-575: Non-thermal Particle Acceleration Associated with a Young Stellar Cluster -O.Reimer

The detection of very-high-energy gamma-ray emission associated with the young stellar cluster Westerlund 2 in the HII complex RCW49 by H.E.S.S. provides ample evidence that particle acceleration to extreme energies is associated with this region. The results from the H.E.S.S. observations towards Westerlund 2 are presented. A variety of possible emission scenarios will be reviewed, ranging from high-energy gamma-ray production in the colliding wind zone of the massive Wolf-Rayet binary WR20a, collective wind scenarios, diffusive shock acceleration at the boundaries of wind-blown bubbles in the stellar cluster, and outbreak phenomena from hot stellar winds into the interstellar medium. These scenarios are compared to the characteristics of the recently detected VHE gamma-ray source HESSJ1023-575, and conclusions on the validity of existing emission scenarios for high-energy gamma-ray production are drawn. A generalization from this detection towards a population of young stellar clusters as putative high-energy particle accelerators is pursued.

P4.5 Discovery of a Pulsar Candidate Associated with TEV source HESS J1813-178 -E.Gotthelf

We present a Chandra X-ray observation of G12.82-0.02, a shell-like radio supernova remnant coincident with the TeV gamma-ray source HESS J1813-178. We resolve X-ray emission from a coincident ASCA source into a point-like object located within the radio remnant surrounded by diffuse emission that fills its shell, a morphology strongly suggesting a pulsar wind nebula (PWN), including faint inner structure. The spectrum of the point source is well-characterized by a power-law with index of $\Gamma = 1.3$, typical of a young, energetic rotation-powered pulsar. For a distance of 4.5 kpc, consistent with the X-ray absorption and an association with the nearby star formation region W33, the total 2-10 keV X-ray luminosity of the system is 2×10^{34} erg s^{-1} erg/s; this implies a spin-down power of $\sim \times 10^{37}$ erg s^{-1}, marking this pulsar as one of the top most energetic in the Galaxy. We consider possible explanations for the origin of the TeV emission, arguing that inverse Compton scattering of ambient photons off relativistic electrons in the PWN nebula provide a self-consistent picture for this source. This result has strong implications for predicting the GLAST source population demographics.

P4.6 Population Synthesis of Radio and Gamma-ray Millisecond Pulsars in the Galactic Disk -S.Story

We present results of a population synthesis of millisecond pulsars in the Galactic disk. Excluding globular clusters, we model the spatial distribution of millisecond pulsars by assuming they are born in the Galactic disk with a random kick velocity and evolve them to the present within the Galactic potential. We assume that ordinary and millisecond pulsars are standard candles described with a common radio emission model invoking a new relationship between radio core and cone emission suggested by recent studies. In modeling the radio emission beams, we explore the relativistic effects of time delay, aberration and sweepback of the open field lines. While these effects are essential in understanding pulse profiles, the phase-averaged flux is adequately described without a relativistic model. We use a polar cap acceleration model for the gamma-ray emission. We present the preliminary results of our recent study and the implications for observing millisecond pulsars with GLAST and AGILE.

P4.7 Monitoring Accreting X-ray Pulsars with the GLAST Burst Monitor -C.Wilson-Hodge

Accreting pulsars are exceptionally good laboratories for probing the detailed physics of accretion onto magnetic stars. While similar accretion flows also occur in other types of astrophysical systems, e.g. magnetic CVs, only neutron stars have a small enough moment of inertia for the accretion of angular momentum to result in measurable changes in spin-frequency in a timescale of days. Long-term monitoring of accreting pulsar spin-frequencies and fluxes was demonstrated with the Burst and Transient Source Experiment (BATSE) on the Compton Gamma Ray Observatory. Here we present sample results from BATSE, discuss measurement techniques appropriate for GBM, and estimate the expected GBM sensitivity.

P4.8 How to reveal mysteries of the most highly obscured sources of our Galaxy? -S.Chaty

The INTEGRAL satellite has discovered a new population of X-ray sources in our Galaxy, which exhibit strange properties. Constituted of a compact object orbiting a supergiant star, they are much more absorbed than most of binary sources known up to now, and have therefore escaped to previous X-ray satellites. These sources seem to hide behind a cocoon of gas and dust, that only observations at other wavelengths, such as infrared, allow to reveal, and understand their nature. I will describe the history of these sources, and how multi-wavelength observations (from high-energy with INTEGRAL, XMM, Chandra to optical, near- and mid-infrared wavelengths with ESO/NTT, VLT) allow to study them. I will show that these sources revolutionise our view on binary systems and their evolution, and that such unexpected discoveries are very likely to arise in the GLAST era.

P6 Gamma-ray Bursts

P6.1 GRB study with GLAST -B.Zhang

Based on the current fireball model of GRBs, in particular the recent observational facts collected by Swift, I will discuss various high energy emission components in GRBs (about 10) and their relative importances. The predictions how GLAST would solve several outstanding problems in the GRB field will be presented.

P6.2 Relativistic interaction of a high intensity photon beam with a plasma: a possible GRB emission mechanism -G.Barbiellini

A long duration photon beam can induce macroscopic coherent effects on a plasma by single photon electron scattering if the probability of the interaction approaches 1 in a volume of unit surface and lenght equal to the plasma typical wavelenght and the induced electron oscillations become relativistic in few plasma cycles. A fraction of the plasma electrons is accelerated through the Wakefield mechanism by the cavities created by the photon-electron interactions and radiates through boosted betatron emission in the same cavities. The resulting emission in this framework is very similar to the typical GRB radiation. Several comparisons with GRB light curves and spectral - energy correlations will be presented.

P6.3 GeV Flares observations with GLAST LAT -E.Galli

Early X-ray afterglow observations show that X-ray flares are very common features in GRB light curves. X-ray flares may reflect long durationcentral engine activity. The delayed flare photons are expected to interact with relativistic electrons by Inverse Compton giving delayed high energy emission counterparts that potentially will be detected by GLAST LAT, which could observe GRB from 20 MeV to more than 300 GeV. The nature of high energy spectral components from GRB detected by EGRET is still debated. Observations with GLAST LAT will give useful information to constrain the origin of X-ray flares. In this work we simulate a set of possible GeV emitting flares in the context of External Shock model to study the capability of GLAST LAT to detect GeV flares at different intensities and durations.

P6.4 Electron inverse Compton model for the prompt and delayed high-energy photon from GRBs -X.Y.Wang

High-energy gamma-ray photons have been detected by EGRET from a few strong gamma-ray bursts during both the prompt and the delayed phases. Here I introduce the electron inverse

Compton (IC) model for these high-energy photons. 1) the prompt phase: when the relativistic GRB ejecta is decelerated by the swept-up medium, two shocks are formed, one is the reverse shock and the other is the forward shock. I discussed the slef-IC processes occured in these two shocks as well as the combined-IC process between the two shocks. These IC processes may produce GeV to TeV emission during the prompt GRB phase; 2) late-time phase: the recent detection of delayed X-ray flares by Swift during the early afterglow phase of GRBs suggests an inner-engine origin. Given the observed temporal overlapping between the flares and afterglows, there must be IC mission arising from such flare photons scattered by forward shock afterglow electrons. We suggest that this IC process can produce delayed GeV photons, such as those detected from GRB940217 by EGRET. I also discuss the prospect of detection of high-energy photons by GLAST from these process and its imiplicaitons for understanding GRB physics at very high energies.

P6.5 GLAST observation of high-redshift GRBs -E.Bissaldi

During the last years, a clear connection between long-duration, soft Gamma-Ray Bursts (GRBs) and powerful Type Ib/c Supernova (SN) explosions has been established. If GRBs reflect the deaths of massive stars, their presence and statistics would provide a superb probe of the primordial massive star formation. They would be by far the most luminous sources in existence at very high redshifts, much brighter than SNe, and most AGNs. We tested whether the hypothesis of Type Ib/c SNe from different massive progenitors can reproduce the local GRB rate as well as the GRB rate as a function of redshift. Possible recent detections of galactic spheroids at $z \simeq 6$ provided sufficient motivation for exploring the Type Ib/c SN rate up to the very high redshifts, assuming an epoch of galaxy formation of $z \sim 10$ in the so-called "monolithic collapse" scenario. We predicted the GRB rate at very high redshift under different assumptions about galaxy formation and star formation histories in galaxies, obtaining more GRBs at high redshift than in the "hierarchical" scenario. Moreover, adopting the Amati relation, we derived the expected luminosities for high-redshift GRB population. The high-energy emission from such population may be observable by the GLAST LAT.

P6.6 GRB spectra in the MeV range: hints from INTEGRAL -T.Bulik

INTEGRAL detects a large number of bursts outside of its field of view with the SPI ACS. Several of these bursts are also detected by IBIS. We present the results of the spectral analysis using the ISGRI, PISCIT, and the Compton mode. These bursts show extremely hard spectra with high energy photon index equal to or larger than -2 above 1 MeV. We thus show that there is a group of bursts with E_{peak} at least in the several MeV range. We discuss the implications of these findings for GLAST.

P6.7 Comparison of VSB from BATSE and SWIFT -D.Cline

We show the locations of the SWIFT short hard bursts (SHB) with afterglows on the Galactic map and compare with the VSB BATSE events. As we have pointed out before, there is an excess of events in the galactic map of BATSE VSB events. We note, that none of VSB SWIFT era events fall into this cluster. More SWIFT events are needed to check this claim. We also report a new study with KONUS data of the VSB sample with an average energy above 90 keV showing a clear excess of events below 100 ms duration (T90) that have large mean energy photons. We suggest that VSB themselves consists of two subclasses: a fraction of events have peculiar distribution properties and have no detectable counter parts, as might be expected for exotic sources such as Primordial Black Holes. We show how GLAST could add key new information to the study of VSB bursts.

P6.8 Adding the GLAST Burst Monitor to the 3rd Interplanetary Network -K.Hurley

The GLAST Burst Monitor (GBM) will produce GRB and SGR positions with roughly 3 degree accuracy. These bursts will be used for a wide variety of studies, from LAT observations to searches for coincident neutrino and gravitational wave emission. By incorporating the GBM into the interplanetary network (IPN) of GRB detectors, the error boxes of many of the stronger events can be reduced to several arcminute size. When GLAST flies, the IPN will consist of the Ulysses, MESSENGER, and Odyssey missions, in interplanetary space, RHESSI, Swift, and Suzaku in low Earth orbits, and INTEGRAL and Konus, at distances up to 4 light-seconds from Earth. I will discuss the anticipated results, based on 9 years of experience with over 900 BATSE/IPN events.

P7 Surveys and Population Studies

P7.1 A Comprehensive Approach to Gamma-ray Source Identification in the GLAST-LAT Era -P.Caraveo

Unveiling the nature of a vast number of unidentified sources is the most compelling problem facing todays high-energy (MeV-to-GeV) gamma-ray astronomy. However, unidentified sources are not peculiar to high-energy gamma-ray astronomy, they have been an ever-present phenomenon in astronomy. Indeed, every time a new astronomical window was opened, astronomers found sources they were not able to identify, i.e. to associate with previously known objects. This can happen either because such sources belong to a genuinely new (thus unknown) class or because their positions are not known accurately enough to allow for an unambiguous association between the newly found emitter and a known object. Thus, the lack of identification is frequently ascribed to poor angular resolution. Being unidentified, however, is a 'temporary' status: sooner or later better tools will allow the source identification, i.e. either its classification within a given class of astronomical objects or its recognition as belonging to a new class. Owing to the intrinsic limitations of gamma-ray detection technique, however, the instruments angular resolution has not yet reached the minimum level required to permit the transition from the unidentified limbo to the paradise of known objects, thus creating a continuing unidentified high-energy gamma-ray source problem. Different approaches towards source identification have been pursued in the past. Here we will review the state of the art as well as the strategies devised for the GLAST era.

P7.2 Constraints on Galactic populations of gamma-ray emitters from the unidentified EGRET sources -J.Siegal-Gaskins

At the time the third EGRET catalog was published, unidentified sources accounted for a substantial fraction of the detections. To this day, the vast majority of these sources have not yet been associated with low-energy counterparts. In addition to known classes of gamma-ray emitters such as pulsars, supernova remnants, and blazars, a number of theoretically motivated candidate emitters have been suggested as the origin of these detections. We take a new approach to evaluate the plausibility of a Galactic population accounting for some or all of the unidentified EGRET sources. Rather than focusing on the properties of a specific candidate emitter, we constrain the abundance and spatial distribution of any objects of Galactic origin possibly lurking among the EGRET unidentified sources by making the simple assumption that galaxies similar to the Milky Way host comparable populations of gamma-ray emitters. We find that it is highly improbable that the unidentified EGRET sources contain more than a handful of members of a Galactic halo population, but that current observations are consistent with all of these sources being Galactic objects if they reside entirely in the disk and bulge. However, upcoming observations by GLAST have the potential to exclude association of a large number of the unidentified sources with any Galactic source class. We discuss the additional constraints and new insights into the nature of Galactic gamma-ray emitting populations GLAST is expected to provide.

P7.3 How to unravel the nature of dark TeV gamma-ray sources -G.Puehlhofer

One of the promises of TeV gamma-ray astronomy has been to identify the acceleration sites of Galactic cosmic rays. In theory, it is expected that the majority of hadronic cosmic rays should be accelerated in Supernova remnant (SNR) shells. The current TeV experiments have indeed been very successful in discovering already numerous Galactic gamma-ray emitters. But surprisingly, the nature of many of these new sources remains a mystery till now. In many cases, counterparts could not yet be identified which would reveal the astrophysical nature of these objects. In other cases, the identification with SNRs is purely based on positional arguments, and the suggested associations are still awaiting confirmation. Moreover, in several cases an association with plerionic rather than shell-type SNRs has been suggested. Now, the interesting questions are: Is a large fraction of the new TeV sources really physically associated with SNRs? Is the emission of these SNRs dominated by shell-type, supposedly hadronic emission, or rather by plerionic and therefore most likely leptonic emission? And have we already detected all relevant source types which contribute substantially to the Galactic cosmic ray energy budget, using the current TeV survey capabilities? The answers to these questions will only become available with the identification of the new TeV sources through multifrequency data. Our current identification program of H.E.S.S. sources will be reviewed.

P7.4 The MeV Point-Source Sky during the COMPTEL Mission -W.Collmar

The COMPTEL experiment aboard CGRO explored the - previously unknown - MeV sky (0.75 - 30 MeV) for more than 9 years, providing a wealth of discoveries. We use all COMPTEL data from the beginning up to the end of the CGRO mission (April 1991 - June 2000) to carry out all-sky point source analyses in different energy bands for different time periods (sum of all data as well as subdivisions). We apply our standard maximum-likelihood method to generate all-sky significance and flux maps for point sources by subtracting off the diffuse emission components via model fitting. The goals of the analyses are to derive 1) a consistent survey on MeV sources for the complete mission, including source searches for yet unknown COMPTEL sources (i.e. not listed in the first COMPTEL catalog), and 2) to derive quantitative results - fluxes, light curves -

for the brighter and more significant MeV sources. We will present the results derived yet: all-sky point source maps for different energy bands and time periods, a summary of the detected MeV sources, and give light curves and time-averaged spectra for some selected bright sources. The non-variable ones might be used for cross-calibration of GLAST/LAT at its lowest energies.

P7.5 Hard X-ray Sources Detected by INTEGRAL and Implications for GLAST -J.Tomsick

Hard X-ray imaging of the Galactic plane by the INTEGRAL satellite is uncovering large numbers of 20-100 keV IGR sources and allowing for monitoring of previously known sources. Although the source type is currently unknown for more than half of the roughly 140 IGR sources, the sources that have been identified include Active Galactic Nuclei, High-Mass and Low-Mass X-ray Binaries (HMXBs and LMXBs), Cataclysmic Variables, and Supernova Remnants. It is uncertain how many of the IGR sources will be detected by GLAST, but 5 of them have possible associations with EGRET or TeV sources. I will present the current status of associations between 20-100 keV and ¿100 MeV sources and discuss what multi-wavelength observations of IGR sources and black hole transients tell us about whether we should expect these sources to be detectable by GLAST.

P7.6 A Statistical Study of EGRET Blazars: Correlation, Regression and Monte Carlo Analysis -S.Bloom

A statistical study of EGRET Blazars (including candidate blazars of Sowards-Emmerd et al.) is presented. Included are new results for the luminosity correlations. A Monte Carlo approach is used in comparing simulated samples to these blazars with varying assumptions of the underlying emission mechanism for gamma-rays (SSC and ECS).

P7.7 X-ray observations of unidentified H.E.S.S. Gamma-ray sources -S.Funk

In a survey of the inner part of the Galaxy (+- 30deg in Galactic longitude, +- 4deg in Galactic latitude), performed with the H.E.S.S. Instrument (High energy stereoscopic system) in 2004 and 2005, a large number of new unidentified very high energy (VHE) gamma-ray sources above an energy of 100 GeV was discovered. Often the gamma-ray spectra in these sources reach energies of up to 100 TeV. These are the highest energy particles ever attributed to single astrophysical objects. While a few of these sources can be identified at other wavebands, most of these sources remain unidentified so far. A positive identification of these new gamma-ray sources with a counterpart object at other wavebands requires a) a positional coincidence between the two sources, b) a viable gamma-ray emission mechanism and c) a consistent multiwavelength behaviour of the two sources. X-ray observations with satellites such as XMM-Newton, Chandra or Suzaku provide one of the best means to studying these enigmatic gamma-ray sources at other wavebands, since they combine high angular resolution and sensitivity with the ability to access non-thermal electrons through their synchrotron emission. We therefore have started a dedicated programme to investigate gamma-ray sources in X-rays and first results are presented.

P8 Astrostatistics

P8.1 Borrowing Statistical Strength: Methods from the Great Observatories for the New Challenges of GLAST -A.Siemiginowsa

During the era of the Great Observatories, interdisciplinary collaborations of astrophysicists, statisticians, and engineers opened new boundaries on methods for very high resolution, low count data. These methods ranged from simple to complex: from correct hardness ratios, and upper bounds for low-count Poisson data; multi-scale methods of image and spectral "deconvolution"; more robust timing analyses; and even goodness-of-fit for high resolution, low count data. How well will these work for the new era of GLAST? This is an interdisciplinary session with statisticians, astronomers and particle physicists designed to explore this question. The goal is to open a discussion and start collaborations on the statistical issues related to the new data expected from GLAST. The strongly energy dependent point spread function (PSF), the dependence of the instrument effective area as a function of off-axis angle, and the continuous scanning motion of the instrument during its normal operation will effectively give each detected photon its own set of instrument response functions. The broad, non-Gaussian tails of the PSF will make source confusion a concern for the fainter sources, especially at energies below about 1 GeV and in regions near the Galactic plane. We will consider source detection, upper limits and understanding the null distribution for point source analysis, image reconstruction and characterization of extended sources, and flare and spectral line detection. The session will provide a forum for discussion and presentation of statistical challenges in high energy astrophysics and a description of new algorithms and methods for data analysis.

P8.2 Statistical Challenges for GLAST LAT Data -J.Chiang

The GLAST LAT will have an order of magnitude greater sensitivity and better angular and energy resolution than its predecessor EGRET and is expected to detect and characterize several thousand new gamma-ray sources during the first year of its operation. It will continuously monitor the entire gamma-ray sky, and with its wide field-of-view, ~ 2 sr, it will give full coverage on time scales of a few hours. It will also provide spectral information over a very broad energy range, 30 MeV–300 GeV. The data that will be made available by these capabilities will present statistical challenges that will be unique to these observations. The strongly energy dependent point spread function (PSF), the dependence of the instrument effective area as a function of off-axis angle, and the continuous scanning motion of the instrument during its normal operation will effectively give each detected photon its own set of instrument response functions. Diffuse emission from the Milky Way will dominate the photons detected by the LAT and uncertainties in modeling this emission will make measurements of discrete sources in the context of these diffuse events difficult. The broad, non-Gaussian tails of the PSF will make source confusion a concern for the fainter sources, especially at energies below ~ 1 GeV and in regions near the Galactic plane. We will describe some of the thornier statistical issues that the LAT team has encountered in trying to analyze simulated LAT data using realistic response functions and models of the gamma-ray sky. These issues will include source detection, upper limits and understanding the null distribution for point source analysis, image reconstruction and characterization of extended sources, and flare and spectral line detection.

P8.3 Multi-Scale Image Reconstruction with Low-Count Poisson Data - D.van Dyk

In this talk we discuss the use of highly structured statistical models for image reconstruction with count-limited data. Our models are designed to capture the complexity of both the cosmic sources themselves and the instrumentation used to observe them. To fit these models, we use Bayesian statistical methods that are well suited to answer relevant scientific questions. Bayesian techniques allow us to combine information in the data with scientific information outside the data such as smoothness constraints on extended emission. Thus, we propose combining a Poisson likelihood that accounts for the low-count nature of the data with a prior distribution that encourages smooth reconstructions. We consider both multi-scale prior distributions that allow for structure on multiple scales in the emission and Markov Random Field prior distributions that allow us to explicitly include information about how smoothness varies across the image. Although such prior distributions are generally formulated in terms of a number of user specified tuning parameters, we show that these parameters can also be fit to the data. In principle these methods can be used to jointly model both spectral and spatial characteristics of the source. The statistical computation that is necessary to fit such highly structured models can be formidable. We propose both EM algorithms for mode finding and Markov chain Monte Carlo methods to fully explore the posterior distribution. The variability of the posterior distribution is a direct measure of uncertainty (i.e., error bars) in the reconstructed image and can be in principle used to quantify confidence in the image.

P8.4 Low-Count Poisson Goodness-of-Fit and Feature Detection: An EGRET Example with EMC2 -A.Connors

What might 'ideal' science processing look like, as each load of GLAST Large Area Telescope (LAT) data comes down from the sky? We suggest it includes: 1/ Comparing the latest data with past best all-sky models and data to see if there have been any statistically significant changes; 2/ Updating the all-sky models accordingly; 3/ Doing this in a systematic way for different time-bins (i.e ., multi-scale in time); 4/ Especially for long time-scales, including capability for finding changes in diffuse emission; and 5/ Without losing resolution to 'rebinning', is my science model a 'good enough' fit to the accumulated data (e.g., the Galactic Diffuse Emission)? Further, 6/ one wants to do this fast enough to keep up with the data flow. The GLAST LAT wide and variable PSF makes this a particular challenge. By using CGRO/EGRET all-sky data, we solve a simplified version of these problems. Using an improved version of EMC2, we demonstrate the use of a (Poisson-specific, likelihood-based) flexible multi-scale model to 'capture' the difference between a 'best' sky model, and data. That is, instead of approximating χ^2 for goodness-of-fit, we use the full Poisson likelihood (with a penalty, or smoothing prior) and MCMC to calculate the fraction of total counts in one's 'best-fit' model, versus those in the flexible multi-scale component. Using this, one can quantitatively answer how well (say), one's model of the Galactic Diffuse Emission matches the data — and without losing intrinsic high resolution (in space or energy) by rebinning to get higher counts per bin. We demonstrate: finding new, irregular, disconnected features; finding faint model-mismatch; and even finding flaring point sources (although point-sources is not its strength). Although it works, there are many practical and computational challenges ahead.

P8.5 Computing Upper Bounds for Contaminated Weak Sources: The Banff Challenge -X.Meng

The Large Hadron Collider (LHC) at CERN is set to produce data within the next 18 months which may shed light on the existence, or otherwise, of the Higgs-Boson particles. One particular type of data that can be expected may be modeled using a system of three Poisson models corresponding to experimental observation in addition to instrumental and background calibrations. With multiple decay channels the dimensionality of the nuisance parameter grows and suitable specification of the prior structure becomes increasingly important. Several Bayesian approaches are explored to provide marginal posterior intervals and percentiles for the parameter of interest. Standard problems with non-informative priors in high-dimensions can be illustrated as the number of channels increases. A systematic approach is taken by analysis of both single-level and hierarchical models, with results for fully Bayesian and Empirical Bayes methods also compared. The goal here is to provide upper limits and confidence intervals with excellent Frequentist coverage properties.

P8.6 Modern Statistical Methods for GLAST Event Analysis -R.Morris

We describe work-in-progress on developing a statistical reconstruction methodology for the GLAST LAT. The methodology incorporates in detail the statistics of the interactions of photons and charged particles with the tunsgsten layers in the LAT, and uses the scattering distributions to compute the full pdf over the energy and direction of the incident photons. It uses model selection methods to estimate the probabilities of the possible geometrical configurations of the particles produced in the detector, and numerical marginalization over the energy loss and scattering angles at each layer. Preliminary results show that it can improve on the tracker-only energy estimates for muons incident on the LAT, and that it can identify where charged particles traversing the LAT produce secondary photons.

P8.7 Algorithms for Detection and Modeling of Sources, GRBs, Quantum Gravity and Dark Matter Signatures -J.Scargle

Novel algorithmic approaches to the detection and characterization of sources, both point and extended, as well as modeling of GRB light curves and detection of quantum gravity and dark matter signals will be presented. Methods based on data segmentation procedures and other modern information technology developments will be described and exemplified using synthetic data.

P8.8 Statistical issues in detecting gamma-ray pulsars -J.Rice

We will discuss our on-going work on methodology for detecting gamma-ray pulsars. The detection problem poses both theoretical and computational challenges. On the theoretical side, there are no compelling optimality results that dictate the choice of a detection algorithm and the properties of detection procedures can be quite difficult to analyze. On the computational side, searching over a range of frequency and frequency drift can be a daunting task, even for a record consisting of only a thousand or so events. We discuss a class of detection procedures, weighted quadratic test statistics arising from likelihood expressions, whose properties we can understand and which do not impose excessive computational burdens. The likelihood function models the photon arrival process as a mixture from background and source and takes into account the point spread function and the energies of the photons with the result that a weight is associated with each photon. We develop expressions which quantify the detection efficiency resulting from these weighted statistics. These results allow us to examine the effects of grid resolution in a search over a broad frequency range. We show that the discretization must be very fine and we discuss the use of integration over frequency bands as an alternative. The analysis allows different weighting schemes to be compared. For example, simple cuts in energy and incidence angle can be compared since they amount to weights which are either zero or one. Efficiencies resulting from such hard cuts can be compared to those arising weighting that arises from the likelihood function.

Poster Sections

Posters will be on display all day Monday and Tuesday. **Please note**: the maximum poster dimensions are 32" wide by 48" tall (please excuse the archaic units).

P12.AGN, EBL, and Related

Bottacini, Eugenio INTEGRAL and multiwavelength observations of the blazar Mrk 421 during an active phase P12.39
Carraminana, Alberto Searching for the first blazars with GLAST and LMT P12.40
Carson, Jennifer E Probing AGN broad line regions with GLAST LAT observations of FSRQs P12.41
Cavazzuti, Elisabetta ROXA: a new multi-frequency selected large sample of blazars with SDSS and 2dF optical spectroscopy P12.1
Cheung, Chi C Compton x-ray and gamma-ray emission from extended radio galaxies P12.2
Ciprini, Stefano XMM-Newton observations of OJ 287 in 2005 and coordinated WEBT campaign P12.3
Collmar, Werner Recent multifrequency campaigns of the gamma-ray blazar 3C 279 P12.4
Foschini, Luigi Swift follow-up of the gigantic TeV outburst of PKS 2155-304 in 2006 P12.5
Georganopoulos, Markos How to corner the two popular x-ray jet models with GLAST, and get the jet speed as freebie P12.6
Graff, Philip B. High energy variability of synchrotron-self compton emitting sources: why one zone models do not work, and how we can fix it P12.7
Grandi, Paola Broad line radio galaxies: jet contribution to the x-ray con-

tinuum P12.8
Healey, Stephen E. The CGRaBS blazars: preparation for GLAST P12.9
Jorstad, Svetlana G. Kinematics of jets in gamma-ray blazars P12.10
Joshi, Manasvita Modeling the SED and variability of 3C66A in 2003/2004 P12.11
Kildea, John AGN monitoring with the whipple 10 m gamma-ray telescope P12.12
Kocharovsky, Vladimir The converter acceleration mechanism for potential sources of ultra-high energy cosmic P12.13
Kurtanidze, Omar M. Long-term ind intraday(?) variability of BL Lacertae since last great outburst P12.14
Kurtanidze, Omar M. Optical variability of x-ray selected blazars P12.15
Kurtanidze, Omar M. Blazars photometry at Abastumani Observatory P12.16
Lindfors, Elina Gamma-ray emission mechanism in blazar 3C279 P12.17
Lisanti, Mariangela Electromagnetic models of extragalactic jets P12.18
Lister, Matthew L Blazar demographics with MOJAVE and GLAST P12.19
Lott, Benoit Studying gamma-ray blazars with the GLAST LAT P12.20
Markowitz, Alex GeV variability analysis of blazars using GLAST LAT P12.21
Massaro, Enrico The multifrequency blazar catalog P12.22
Miller, H. R. Optical variability of GLAST blazars P12.23
Mizuno, Yosuke Relativisitc MHD simulations of relativistic jets with RAISHIN P12.24
Nandikotkur, Giridhar Does the blazar gamma-ray spectrum harden with increasing flux? - what we learned frp, EGRET P12.25
Niemiec, Jacek The role of the first-order fermi process in particle production at untrarelativistic shocks P12.26
Nishikawa, Ken-Ichi Simulation study of magnetic fields generated by the electromagnetic filamentation instability P12.27
Poutanen, Juri Photon breeding in relativistic jets P12.28
Reimer, Anita GeV-photon absorption in cosmologicallyevolving quasar environments P12.29
Reyes, Luis C Detecting the EBL attenuation of blazars with GLAST P12.30
Rhoads, James E Probing early star formation with GeV pair creation cutoffs in GRB spectra P12.31
Stawarz, Lukasz Automatic quenching of high energy gamma-ray sources by synchrotron photns P12.32
Stawarz, Lukasz Direct and reprocessed gamma-ray emission of large-scale jets in radio galaxies P12.33
Takahashi, Hiromitsu Multi-wavelength observationsof galactic microquasars

P12.34
Tornikoski, Merja Radio to gamma-ray connection in blazars P12.35
Tramacere, Andrea The giant x-ray flares of Mrk 421 in spring-summber 2006 P12.36
Weintraub, Lawrence C Long-term daily monitoring of blazar candidates at 15 GHz P12.37
Yu, Wenfei State transitions in microquasars and the search for microblazars P12.38

P13.Surveys and Population Studies

Funk, Stefan The connection between the LAT and VHE gamma-ray instruments P13.1
Casandjian, Jean-Marc A revised catalogue of EGRET sources P13.2
Kieda, David B GeV/TeV source population statistics extrapolated from the HESS galactic plane survey P13.3
Lonjou, Vincent Source identification with GLAST P13.4
Walker, Gary P A milagro sky survey optimized for soft-spectrum sources P13.5
Roberts, Mallory S.E. What will be the brightest GLAST sources in the Galaxy? P13.6
Cillis, Analia N Population studies of gamma ray sources using stacking analysis at low galatic latitudes P13.7

P14.Galactic Compact Objects and Their Environments

Djannati-Atal, Arache Relic electron glow in middle-aged pulsar wind nebulae: a new class of VHE sources revealed by HESS P14.1
Dubois, Richard Prospects for observations of microquasars with GLAST P14.2
Forot, Michael Very high-energy particles in the tails of geminga P14.3
Forot, Michael Gamma-ray polarization of the crab nebula between 200 and 800 keV P14.4
Fukazawa, Yasushi Simultaneous observation of the gamma-ray binary LS I-61 303 with GLAST and Suzaku P14.5
Funk, Stefan Future GLAST observations of Supernova remnants and Pulsar Wind Nebulae P14.6

Guillemot, Lucas Preparations for GLAST LAT observations of the millisecond pulsar PSR J0218+4232 and its blazar neighbor 3C 66A P14.7
Hideaki, Katagiri GLAST simulation study of TeV-emitting extended supernova remnants for the origin of cosmic-ray nuclei P14.8
Hirotani, Kouichi The Impact of GLAST on pulsar emission models P14.9
Kamae, Tune Simulation of gamma-ray emission by protons and electrons in a 3D model of SNR shells P14.10
Lemiere, Anne Time dependent modeling of the archetypal middle-age gamma-ray PWN HESS J1825-137 P14.11
Lemoine-Goumard, Marianne Observations of the shell-type supernova remnants RX J1713.7-3946 and RX J0852.0-4622 with H.E.S.S. P14.12
Niemiec, Jacek Magnetic turbulence production by streaming cosmic rays upstreamof SNR shocks P14.13
Otte, Nepomuk Pulsars and plerions observed with the MAGIC telescope P14.14
Parent, Damien Search for PSR B1951+32 with the GLAST LAT P14.15
Porter, Troy A Very high energy gamma rays from supernova remnants P14.16
Razzano,Massimiliano GLAST LAT and pulsars: what we learn from simulations? P14.17
Romani, Roger W Gamma-ray pulsar candidates for GLAST P14.18
Shrader, Chris R A search for short-lived transient phenomenon in LS I+61 303 P14.19
Shrader, Chris R Gamma-ray emission from x-ray binaries: prospects for GLAST P14.20
Slowikowska, Agnieszka Fully resolved optical polarization of the crab pulsar P14.21
Sturner, Steven J The gamma-ray properties of the young, high-field pulsar PSR J1846-0258 P14.22
Takata, Jumpei Phase resolved spectrum, light curve and polarization of high-energy emissions from the crab pulsar P14.23
Terrier, Regis The galaxy at very high energies: constraints on the cosmic-ray electron sources P14.24
Thierry, Reposeur Early vela pulsar observations to check GLAST LAT performance P14.25
Almohammad, Abdalla H Determination of physical and geometrical elementof short period eclipsing variables 44i boo P14.26
Asvarov, Abdul Gamma-rays from radiative supernova remnants P14.27
Boettcher, Markus Implications of the VHE gamma-ray spectral variability of LS 5039 P14.28

Butt, Yousaf M. A radio shell counterpart of TeV J2032+4130? P14.29
Cassam-Chenai, Gamil The blast wave of tycho's supernova remant P14.30
Chernenko, Anton On the evolution of gamma-ray phase curves of radio pulsars and their detection with GLAST P14.31
Gonthier, Peter L. Population statistics of normal radio and gamma-ray pulsars in the galactic disk P14.32
Ziegler, Marcus Searching for radio-quiet gamma-ray pulsars P14.33

P15.Facilities

Carraminana, Alberto A fast camera for gamma-ray pulsars P15.1
Dingus, Brenda L. HAWC (High Altitude Water Cherenkov) obervatory for surveying the TeV sky P15.2
Naoki, Isobe High sensitivity all sky x-ray monitor and survey with MAXI P15.3
Norris, Jay P. Near-IR camera for coordinated observations of high-energy transients alerted by Swift and GLAST P15.4
Piotrowki, Lech W "Pi of the Sky" project P15.5
Pozanenko, Alexei Synchronous wide field survey: search prompt GRB emission in optic P15.6
Smith, Andrew J Capability of extended air-shower arrays for gamma-ray astronomy P15.7
Taylor, Greg B A view of clusters, AGN, and GRBs from the other side of the spectrum: the long wavelength array P15.8
Vestrand, W. Thomas Building 'thinking' telescopes to support GLAST P15.9
Villata, Massimo WEBT multifrequency support to the GLAST mission P15.10

P16.GRB and Solar Physics

Akerlof, Carl W Statistical estimates of coordinate error circles for LAT-detected GRBs P16.1
Band, David L. The synergy between the LAT and GBM in GLAST's Study of gamma-ray bursts P16.2
Bastieri, Denis MAGIC upper limits on thehigh energy emission from GRBs P16.3
Briggs, Michael S. GBM on-board triggering and locations P16.4
Cohen-Tanugi, Johann Time dependence of pair opacity in GRB internal

shocks P16.6
Galli, Alessandra GeV flares observations with GLAST LAT P16.7
Gupta, Nayantara Detecting high energy photons from GRBs with GLAST P16.8
Johannesson, Gudlaugur Luminosity distribution of GRB afterglows P16.9
Kazanas, Demosthenes The "Supercritical pile" GRB model: predictions for GLAST P16.10
Kocevski, Daniel Timing analysis of x-ray flares in GRBs P16.11
Komin, Nukri R Performance of the GLAST-LAT for the observations of GRB spectra P16.12
Le, Truong V Gamma ray bursts in the Swift and GLAST era P16.13
Longo, Francesco Gamma-ray burst observations with GLAST and TeV observatories P16.14
Longo, Francesco GLAST LAT detection of solar neutrons P16.15
Murphy, Ronald J. GLAST measurements of pion decay emission in solar flares P16.16
Saz Parkinson, Pablo M Search for very high energy emission from gamma-ray bursts using milagro P16.17
Omodei, Nicola LAT observation of GRBs: simulations and sensitivity studies P16.20
Stacy, J.G. A program to search for transients microwave emission from GRBs and other high energy sources using archival WMAP datasets P16.18
Williams, David A. Search for GeV emission from gamma-ray bursts using milagro scaler data P16.19

P17.Diffuse and Extended Sources

Bhattacharya, Debbijoy Contribution to the exragalactic gamma-ray background (EGRB) from discrete sources P17.1
Gillard, William Effects of the gas content on the gamma ray emission from the galactic bulge P17.2
Grasso, Dario TeV gamma-ray and neutrino diffused emission from the galaxy P17.3
Iocco, Fabio High energy signals from the first stars P17.4
Karlsson, Niklas Simulation of gamma-ray from proton interaction in proton accelerations sites P17.5
Kawano, Naomi Suzaku observations of nonthermal x-ray emission from galaxy clusters P17.6
Mizuno, Tsunefumi Diffuse hard x-ray/gamma-ray emission from galaxy and

local group of galaxies P17.7
Moskalenko, Igor GLAST observations of the sun and heliosphere: what can we learn? P17.8
Moskalenko, Igor Developing the galactic diffuse emission model for the GLAST large area telescope P17.9
Orlando, Elena GLAST detectability of gamma-ray emission from photon fields of luminous stars P17.10
Ormes, Jonathan F Cosmic ray electron science with GLAST P17.11
Pohl, Martin The 3-D distribution of gas in the milky way galaxy P17.12
Strong, Andrew W The nature of the diffuse continuum emission above 100 keV from the galactic ridge P17.13
Weidenspointner, Georg What can we learn from and about the large magellanic cloud with GLAST? P17.14
Moiseev, Alexander A LAT perspectives in detection of high energy cosmic ray electrons P17.15
Orlando, Elena The extended solar emission - an analysis of the EGRET data P17.16

P18.Dark Matter and New Physics Search Windows

Conrad, Jan GLAST sensitivity to cosmological dark matter annihiliations into gamma-rays P18.1
Morselli, Aldo Searching for point sources of dark matter annihilation with GLAST P18.2
Moskalenko, Igor Dark Matter in the Center of the Milky Way and the stars burning it P18.3
Sanchez-Conde, Miguel Angel Dark matter in draco: new considerations of the expected gamma flux P18.4
Scargle, Jeffrey D. Quantum-gravity based photon dispersion in GRBs: the detection problem P18.5
Stark Schneebeli, Luisa Sabrina Indirect dark matter search with the MAGIC telescope P18.6
Wunderer, Cornelia B Searching for millisecond flares in INTEGRAL and RHESSI GRBs - toward probing quantum gravity with gamma-ray bursts P18.7
Bloom, Elliott D GLAST LAT WIMP line sensitivity estimates P18.8
Lionetto, Andrea Michele Explore physics beyond the standard model with GLAST P18.9

Riofrio, Louise M Supermassive primordial black holes in space/time P18.10

P19.Techniques, Calibrations, and Operations

Band, David L. The GLAST guest investigator program P19.1
Bastieri, Denis Energy calibration of cherenkov telescopes using GLAST data P19.2
Bhat, Narayana P GLAST burst monitor signal processing system P19.3
Bongland, Anders W GLAST LAT performance monitoring P19.4
Branden, Allen T Energy estimation and determination of energy spectra from TeV sources with milagro P19.5
Burnett, Toby Localization of gamma-ray point sources with theGLAST LAT P19.6
Burnett, Toby Application of HEALpix pixelization to gamma-ray data P19.7
Cameron, Robert A The GLAST LAT instrument science operations center P19.8
Campana, Riccardo A MST algorithm for source detection in gamma-ray images P19.9
Case, Gary L Monitoring the low-energy gamma-ray sky using earth occultation with the GLAST GBM P19.10
Cecchi, Claudia Preliminary Study of the LAT Point Spread Function GLAST is the next generation telecope for the study of Gamma Ray Universe P19.11
Charles, Eric A LAT on-orbit performance monitoring and calibration P19.12
Chiang, James Automated science processing for GLAST LAT data P19.13
Ciprini, Stefano 1D, 2D, 3D wavelets methods for gamma-ray point source analysis P19.14
Corbet, Robin H.D The use of weighting in periodicity searches in all-sky monitor data - applications to the GLAST LAT P19.15
Grove, J. Eric Performance of the calorimeter of the GLAST LAT P19.16
Hoover, Andrew S Validation of the GLAST burst monitor instrument response simulation software P19.17
Horner, Donald J The GLAST science support center P19.18
Johnson, Robert P The GLAST silicon-strip tracker P19.19
Kuehn, Frederick G LAT onboard science: gamma ray burst identification P19.20
Latronico, Luca Response of the GLAST-LAT calibration unit to sources of background P19.21
Loredo, Thomas J Holistic source detection P19.22
Lott, Benoit A set of tools for determining GLAST's performance in specific